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APOLLO MONTHLY PROGRESS REPORT (U)

NAS9-150

1 May 1963

This report covers the period from 16 March to 15 April 1963.

CLASSIFICATION CHANGE
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NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

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CONTENTS

PROGRAM MANAGEMENT

STATUS SUMMARY

Mock-up 2 (command module cabin interior arrangement) was delivered for NASA checkout. This is the last of the major mock-ups required for the Apollo program.

The boilerplate 12 structure was accepted by NASA and is presently in the final installation area.

The launch escape motor for boilerplate 6 was shipped to WSMR during the report period, and the spare launch motor is now ready for shipment.

The launch escape tower for boilerplate 6 was delivered to Apollo Test and Operations. This is the third launch escape tower delivered under the current program.

All boilerplate 6 GSE is scheduled to be completed during the next report period.

Two drogue chute and 2 three-chute ringsail cluster tests were successfully performed during the report period.

CONTRACTS

Firm Cost Proposals Submitted to NASA

A budgetary and planning estimate for additional equipment required to perform weight and balance tasks at WSMR and AMR was submitted to NASA.

Contract Amendments

Supplement D to Amendment 3, Contract NAS7-90 was completed and returned to NASA during the report period.

The repair, overhaul, and modification plan and its contractual philosophy were submitted to NASA during the report period.

ASSOCIATE CONTRACTOR RELATIONS

Proposed interface coordination and control procedures were submitted to Grumman and Convair for approval.

The interface control document for the spacecraft/Little Joe II interface was submitted to Convair for approval.

SUBCONTRACT STATUS

The negotiation bases for ten of the major subcontractors have been presented to NASA for review. Negotiations are currently in process with two additional contractors. The target dates for the balance of the negotiations are as follows:

Subcontractor	Target Date
Aerojet	June 1963
AiResearch	May 1963
Collins	May 1963
Marquardt	May 1963
Minneapolis-Honeywell	May 1963
Northrop-Ventura	May 1963
Pratt & Whitney	May 1963
Douglas	May 1963

NEW PROCUREMENTS

During the report period, Emertron, Incorporated was selected as the contractor for the operational beacon antennas. Contract negotiations have been initiated and the contract award is planned early in the next report period.

On 10 April 1963, NASA-MSC awarded the subcontract for the Apollo mission simulator to the General Precision Corporation, Link Division.

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Following is a list of items to be ordered, together with their anticipated order dates:

Items	Target Date
Radome	May 1963
2 kmc antenna	May 1963
In-flight test system	May 1963
Propellant quantity indication system	May 1963
Propellant gauging system	May 1963
TV camera	May 1963

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DEVELOPMENT

TECHNOLOGY

Flight Performance and Control

Initial deployment conditions of the drogue and main parachutes were studied. Results indicated that an adequate separation between the command module, apex cover, and the drogue chute would be attained. The results also indicated that the initial low-altitude abort conditions at main chute deployment would consist of a rotational rate of 150 degrees per second and an 80-degree attitude deviation from the heat shield forward trim point.

Due to the thermodynamic base heating problem, separation studies were conducted to determine the clearance and the effects when the service propulsion system (SPS) nozzle was moved 10.65 inches aft. The results from these studies indicate no clearance problem between the SPS nozzle and the booster. The relocation will require an additional 10-inch separation between the spacecraft and booster before igniting the SPS. This additional separation will, in turn, increase the probability of losing the inertial measurement unit attitude reference during certain module aborts. Studies are being made to determine the effects and corrective measures to be taken if the inertial measuremcnt attitude reference is lost.

Investigations were made on the effects of adverse winds on launch complexes and pad abort capability at AMR. The results are as follows:

1. Winds from an easterly direction will drift the command module toward the launch pad. For winds during the worst season and possible launch escape system (LES) trajectories, there is a 10 percent probability of the command module drifting within 2000 feet of the pad. The probability of drifting within 1000 feet of the pad is only 3 percent.

2. Ideal conditions under which a launch may attain a 90 percent probability of landing farther than 1500 feet from the booster are possible only 14 percent of the time.

3. The probability of the command module colliding with the liquid hydrogen tank on the east side of Pad A, launch complex 37, is one in 50,000.

A continuing study of stabilization and control system (SCS) requirements included simulation of thrust vector control (TVC) capability for abort operations during translunar injection. The study was completed and the results show the following requirements or constraints to be applicable to the SCS:

1. The SCS should have a vehicle command rate limit of 0.17 radians per second.

2. Greater command rates will require decreased gains to maintain stability. Decreasing the gains, however, will prevent recovery from an initial attitude error of 60 degrees within 10 seconds as required.

3. Satisfactory abort operation was achieved with a command rate limit of 0.17 radians per second, when using attitude gains of 1 and 5.5 and rate gains of 0.5 and 3.8 respectively for light and heavy vehicles.

4. An abort operation does not require an actuator with a higher bandwidth than that required for normal operations. A first-order clutch loop bandwidth of 20 radians per second is satisfactory.

5. TVC is capable of effecting a recovery from a combination of initial vehicle attitude errors up to 0.9 radians and rates up to 0.3 radians per second.

6. A spring rate of the service propulsion gimbal actuators and engine mount of 10^5 pounds per foot, a factor of 10 lower than the nominal value previously used, yields satisfactory abort performance.

The optimum propellant tank size for the lunar excursion module has been studied. The study shows that with a manned lunar excursion module plus a 1000-pound payload the tank should provide for a maximum propellant loading equal to 12 percent ΔV margin. The maximum lunar excursion module gross weight (i.e., manned; propellant tanks full plus a 1000-pound payload) would be 28,500 pounds. The minimum lunar excursion module gross weight would decrease to 23,000 pounds with no payload and propellant for a 10 percent ΔV margin.

Thermal and Fluid Dynamics

The best way to dispose of excess propellant in the command module reaction control system (RCS) for landing after an altitude abort or after reentry is to burn off the propellant. This burn-off will require 217 seconds

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and can be accomplished after parachute deployment. For pad abort, propellant can be disposed of by dumping the fuel through the engine and by dumping the oxidizer through a separate line provided for this purpose.

Several nozzle configurations for the command module RCS engine were compared. These configurations were comprised of combinations of three bell nozzles and three throat inserts designed for 1000:1, 40:1, and 10:1 expansion nozzles. A "best fit," an 80 percent bell nozzle contour, was analyzed with each throat insert design. This comparison revealed the 10:1 insert-nozzle combination as optimum. Performance of a 10:1 nozzle with a 40:1 throat insert combination compares favorably with the optimum 10:1 insert-nozzle combination.

Convective heating rates and aerodynamic shear stresses during three boost and reentry trajectories were computed for 52 points on the surface of the command module. This computation, the second iteration of boost and reentry heating estimates, presents a broader temperature profile of the command module surface than the initial computation. The computation is based on more comprehensive wind tunnel test data. The results of this iteration reveal no drastic changes in the original temperature estimates.

A parametric analysis of thermal effects was made on the radiation interchange between the SPS nozzle and the heat shield located on the aft bulkheads. The results indicate a maximum heat shield temperature of 1710 F and a maximum engine nozzle temperature of 2560 F. Since the latter temperature exceeds the nozzle extension limit of 2400 F, an investigation is necessary to find an optimum engine position. Heat shield configurations for various engine positions will also be investigated. Initial analysis of longitudinal temperature distributions on the heat shield for an 84-hour translunar coast mission, cold-case, indicates temperatures as low as -233 F. Further analysis is being made to obtain a complete temperature profile.

The Apollo master radiation shielding computer program, which has been under development for the past six months, was completed and checked out. This program will be used to calculate primary proton radiation effects upon the Apollo spacecraft structure and its occupants.

Analysis is in process of the flow field around the lunar excursion module and command module. Estimates have been made of the base pressure on the command module as a function of its separation distance from the service module. An analysis is being made of the jet effects on the lunar excursion module when the LES motor is burning. Data analysis of lunar excursion module wind tunnel jet effects tests indicates that (1) the

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axial force increases significantly with jets on, (2) the normal force decreases due to a general decrease in local angle of attack of the flow over the command module, (3) the jets destabilize the LES, and (4) the aspirating action of the jets causes a significant difference between actual and theoretical results.

Heat transfer tests of various Apollo module combinations were completed in the AEDC-VKF Tunnel C. Heating rates on the strakes and the effect of the strakes on the command and launch configuration heat transfer distributions were obtained at Mach number 10. These data will be used to define and establish basic design criteria for the strakes.

Life Systems

A universal hand tool is being developed for maintenance and adjustment of equipment in the command module. The tool will be capable of torquing, ratcheting, cranking, and pulling. Design criteria for the tool include a fold-down crank on one end and a 0.5-inch drive ratchet mechanism on the other end.

The tool would have the following possible applications:

1. Manual actuation of non-time critical environmental control system (ECS) components
2. Manual actuation of astro-sextant doors
3. Removal and replacement of lower equipment bay components and electrical connectors
4. Removal and replacement of main display panel components and electrical connectors
5. Control for navigation and guidance.

One wick-type water separator (complete with associated water delivery pumps) of the same configuration as that used in the Apollo water management system will be delivered to NASA during the next report period for further development and testing.

Revision of the flight crew performance specification has been started.

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Simulation and Trainers

The modified engineering simulation program is oriented to reentry, boost, abort, and space operation flight. A transition from the use of engineering evaluators to engineering simulators will occur when prototype spacecraft systems are evaluated in a computer closed-loop dynamic environment. Documentation that defines the objectives, requirements, and simulation procedures for the major elements of the program has been established.

Structural Dynamics

The digital computer program for analyzing the tumbling-type of earth landing has been checked out and initial calculations have been made. Comparison of these calculations with boilerplate 1 drop test results indicates that good correlation is being obtained. For example, the amount of stroke calculated for the couch strut system in a particular landing was within 10 percent of that measured in an actual drop test.

Using full-scale models for the development tests to determine the earth landing impact parameters of the spacecraft is expected to be time consuming and expensive. Therefore, an earth impact test program using one-quarter scale models of the Apollo spacecraft will be started. A total of 24 models will be constructed to simulate the expected structural deformation characteristics of the Apollo spacecraft. The ground deformation properties will also be modeled. The data obtained from this test program will be extrapolated to full scale for the spacecraft.

A stability envelope for water landings was determined using a 0.10-scale model. Stability in this instance was defined as the vehicle floating upright after coming to rest as opposed to floating on its side. Current static flotation stability calculations indicate that for present center of gravity locations, the command module will have two flotation attitudes— one upright (10 degrees to 25 degrees) and the other overturned (120 degrees to 145 degrees). Both model and boilerplate tests are in agreement with these calculations.

To date there is no test program to determine modal and vibration response tests of the complete spacecraft. A test program has been prepared for the second house vehicle, spacecraft 006. This program includes acoustic tests of the complete spacecraft and environmental vibration tests during selected systems operation.

Systems Integration

Several command module/lunar excursion module docking concepts are presently being evaluated. These concepts include automatic probe and drogue, manual probe and drogue and docking ring, trapeze, stub tower, and expanding ring. This evaluation encompasses areas of human factors, design, stress, loads and weights, dynamics analysis, aerodynamic and thermal effects, reliability, and simulation. The evaluation will lead to a recommendation by S&ID of a preferred docking system.

The basic effort on the lunar excursion module adapter trade-off study has been directed toward investigation of lunar excursion module mounting provisions within the adapter. An exploratory meeting between S&ID and Grumman disclosed that the lunar excursion module launching gear may consist of an outrigger-type construction. Using available data, the study has been extended to analyze the outrigger versus the S&ID tension sheet-type support mounting structure. Adapter and lunar excursion module mounting criteria were presented at a recent NASA panel meeting. These criteria, as amended by the panel, were accepted as preliminary, pending a firm lunar excursion module configuration. Detail adapter design is contingent upon finalization of the lunar excursion module envelope and landing gear configuration by Grumman.

An investigation of potential missions for spacecraft 009 indicates that it could best be used for an unmanned orbital mission. The primary objectives of such a mission would be to demonstrate the thermostructural integrity of the heat shield and the space operation of the SPS. This information is required to assure crew safety for the subsequent spacecraft 011 manned orbital flight. To accomplish an unmanned flight, it is necessary to automate certain crew functions which would, in turn, require the selection or design of an on-board programmer and an updata link for initiation of these functions.

SPACECRAFT AND TEST VEHICLES

Structures

Thermal structural testing and evaluation of candidate ablator materials are continuing for the alternate heat shield program. Thermolag T-500 in a 0.25-inch matrix exhibited cracking and matrix separation at -190 F.

The incorporation of a 30-degree pitch angle to the boilerplate command module has considerably reduced g levels during impact testing. Three land impact tests onto a 6-degree up-slope were accomplished using

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a modified crushable landing edge. Although the increased pitch angle reduced impact g levels, the tests indicate that further structural modification may be required to duplicate more closely spacecraft response.

The test setup of the service module radial sheer web test was completed and structural testing will be initiated during the next report period. Two of the six separation tests that must be accomplished satisfactorily before flight of boilerplate 6 (forward compartment cover and launch escape tower separation tests) will be started during the next report period.

The launch escape motor static firing test to provide preflight structural qualification for the tower structure was performed 12 April 1963.

Tests to determine the strength, load deflections, and failure mode characteristics of the launch escape tower fittings were completed successfully. The specimen was first tested with the ultimate design load and then with 150 percent of the ultimate load. No failure resulted.

A study to determine the feasibility of attaining a favorable center of gravity without a movable crew couch is in progress as the result of a design review by NASA and astronaut personnel on 3 April. At that meeting, NASA indicated preference for a fixed couch concept wherein the couches would be designed to remain in one position in both the X-X and Z-Z planes to eliminate the large number of manual mechanical adjustments performed by the astronauts during the critical mission phases prior to and immediately after entry. In addition to decreasing astronaut tasks, the NASA fixed couch concept offers weight savings of several pounds per couch due to the deletion of adjusting mechanisms. This concept, however, represents a departure from the present design that would markedly affect the schedule.

Concurrently, modification of the existing couch design continues because it was demonstrated that an astronaut in an inflated pressure suit cannot be shifted to the 66-degree angle required by the present design. Of the potential 11-inch center-of-gravity shift, 5 inches are lost when the closed angle is opened to 90 degrees, which appears to be the maximum amount of jack-knifing tolerable to an astronaut.

NASA has authorized development of a program to design and manufacture eight nose caps and 60 ground test specimens of the two ablative materials for use in a supercircular reentry test program to be conducted by Langley Research Center.

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Telecommunications and Instrumentation

An analysis has shown that simultaneous transmission of biomedical/ suit parameter analog data and pulse code modulation (PCM) telemetry is feasible over the VHF/FM link in near-earth phases. The unified S-band link will be used for deep space transmission of this information.

Because of the failure previously experienced, the traveling wave tubes for the S-band power amplifier are being given a 200-hour burn-in by the manufacturer to verify reliability before delivery to Collins. Two tubes received by Collins operated satisfactorily.

The feasibility study of an alternate to the VHF/2kmc omni discone antenna was completed. The present antenna will be replaced with VHF and 2kmc scimitar-type antennas to be located in the strakes. The VHF antennas are to survive entry; the 2kmc antennas need not survive. Current effort is aimed towards the establishment and implementation of a schedule so that the antenna change may be incorporated in spacecraft 009.

The instrumentation system for boilerplate 6, including the operational tape recorder, has been installed and checked out.

Boilerplate 12 installation design is complete except for the recently imposed design requirement for three cameras. One camera is to be installed in the dome of the egress hatch and another in the center of the service module. These cameras will view the separation of the launch escape tower and command module. The third camera is to be mounted in the launch escape tower ring to view the launch escape motor plume. Breadboard checkout is scheduled for completion one week after delivery of the final five of the required 192 instrument components provided by NASA for this boilerplate.

Data were obtained on all but five of the 131 channels measured during the Lockheed Propulsion Company test conducted on 12 April. Of the five channels that failed, one failed prior to the test and four failed during the test.

Environmental Control System

Test results indicate that aluminum alloy 6061 cannot be used as tubing for the water management system because of its corrosive characteristics. Specimens of the alloy were filled with distilled water that had various alkaline-acidity ratio (pH) levels and a specific resistance of 200 kilohms. The specimens were sealed from atmospheric contamination, and the pH increase and the specific resistance decrease were recorded

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daily for 21 days. The greatest changes occurred during the first seven days, with a pH increase of 6.9 to 9.2 and a specific resistance decrease of 200 to 48 kilohms. Water removed from the specimens at the completion of the test contained hydrate aluminum oxide. These test finding demonstrated that aluminum alloy 6061 corrodes excessively. Because of these findings, an investigation is being conducted to determine the feasibility of using anodized aluminum or stainless steel tubing for the water management system.

Overboard dumping of water and urine will be done through a common line in place of separate lines as was previously planned. Also, instead of routing the common line through the vapor-vent duct in the command module cabin, it will be routed through the outlet end of the vapor-vent duct. Thus the potential problem of fluid freezing is shifted so that it can be handled in a more accessible area.

By rerouting, the length of the urine line and the weight of the waste management system are reduced, and the pressure drop along the line is decreased.

Electrical Power Systems

Contract negotiations with Pratt & Whitney have been initiated on the fuel cell power plants. Some minor technical aspects of the fuel cell procurement specification have been deferred pending negotiation completion.

The first preprototype model of the Apollo battery has been fabricated and is presently undergoing general performance requirements tests. A pyrotechnic battery specification has been sent to various suppliers for review. Proposals are expected during the next report period. Performance testing of the battery charger breadboard has been completed. Results of the test show the battery charger breadboard to be acceptable.

The breadboard static inverter was delivered to S&ID. The inverter booster transformer was redesigned to eliminate switching voltage transients caused by leakage inductance.

A new load analysis for the reentry post-landing battery shows that the present battery capacity is adequate. This battery will be used in place of the fuel cell during reentry.

Two batteries will be added to the command module, so that there will be a separate source of electrical energy to initiate the pyrotechnic devices aboard the Apollo spacecraft.

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Electronic Interfaces

Results from an investigation of comparative weight, volume, power consumption, and reliability of lamps for event indicators on the main display panel indicate a 28-volt lamp system to be superior. The reliability portion of the study is not completed, but favorable preliminary results were obtained from vibration tests that considered maximum vibration levels and maximum acceleration levels for all mission phases. Additional vibration and life tests are being conducted to increase the confidence level of the reliability test results.

Coordination with Collins Radio Company personnel resulted in the completion of specification control drawings that define the type and location of coaxial connectors for communications equipment.

Lower equipment bay structure and packaging requirements have been defined. The tolerance accumulation between the electronic packages, coldplates, and structures was resolved by establishing appropriate tolerance limits between these interfaces.

The in-flight test system specification was released.

Service Propulsion System

The first simulated SPS engine was delivered to S&ID during the report period. Preparations are being made to install the engine in test fixture F-3.

NASA has confirmed the AEDC request that the dates for occupancy of the simulated altitude test cell and first SPS engine firings be changed from 1 May to 10 May and from 15 May to 10 June, respectively. Presently, no extension of the 12 October completion date is indicated.

During this report period, 72 injector firings were accomplished. Fifteen subscale characteristic exhaust velocity (C*) determinations were made on injectors A-12 and A-13, using both steel and ablative thrust chambers to establish the variation of C* associated with use of an ablative thrust chamber. The remaining 54 injector firings are outlined in Table 1.

Design effort has been initiated to move the service propulsion engine 10.8 inches aft from its present position. This is to alleviate excessive heating of the engine nozzle extension caused by the radiation restriction introduced by the service module aft bulkhead.

SPS propellant tank door interface problems have been resolved by adding a shear ring and provisions for a larger O-ring to the door. Existing

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Table 1. Injector Development Test Program
Apollo Service Propulsion Engine

Serial Number	Pattern Designation and Type	Type of Evaluation	Number of Firings	Stability Characteristics	Remarks
AF-31	POD-31-3 Long Impingement Triplet	Pattern	7	1 unstable 6 stable	First AEDC injector
		C* Determination	6	1 unstable 5 stable	
AF-30	POD-31-3 Long Impingement Triplet	Pattern	5	2 unstable 3 stable	Backup AEDC injector Instability caused by improper valve timing
		C* Determination	6	Stable	
AF-8	POUL-21-1 Unlike Doublet	Pattern	9	3 unstable 6 stable	
		Heat rejection rates	4	2 rough 2 stable	Rough starts due to valve timing
AF-9	POD-31-3 Long Impingement Triplet	Pattern	1	Unstable	
AF-34	PONX-51-2 Quadlet	Pattern	3	1 unstable 2 stable	
		C* Determination	2	1 unstable 1 stable	Fuel line weld crack at injector— Scrapped

C* = Characteristic exhaust velocity

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Table 1. Injector Development Test Program
Apollo Service Propulsion Engine (Cont.)

Serial Number	Pattern Designation and Type	Type of Evaluation	Number of Firings	Stability Characteristics	Remarks
BF-7 (Baffled)	POD-31-10 Long Impingement Triplet	Pattern	2	Stable	
		Extended duration	2	Stable	Weld cracks on baffles - Being reworked
AF-5	POD-31-3 Long Impingement Triplet	C* Determination	6	4 unstable 2 stable	
		Heat rejection rates	2	Rough starts	
AF-1	POD-31-3 Long Impingement Triplet	Induced instability	1	Instability induced by 5-grain charge	Weld cracked on oxidizer manifold - Being reworked
BF-12 (Baffled)	POHL-21-4 Long Impingement Doublet	C* Determination	1	Stable	Weld cracks on all radial baffles - Scrapped
BF-8 (Baffled)	POD-31-8 Long Impingement Triplet				Cracked baffles - Scrapped

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tank door forgings will be salvaged by a reforging operation that will reshape the forgings to new design requirements and improve the grain structure.

Planning and implementation of the manned-mated propulsion tests of spacecraft 001 at WSMR will proceed with the following modifications:

1. The proposed ECS will be simplified.

2. The vapor detection system will be extended to include hydrogen and oxygen and, if feasible, it will be made part of the facility vapor detection system.

3. Radio frequency communication will be manual instead of automatic, and provision will be made for a side tone.

4. Bioinstrumentation will be provided according to a list of suggested measurements to be supplied by MSC.

The test stand configuration for those spacecraft 001 propulsion tests that incorporate a mating of the command and service modules (with crewmen in the command module) has been determined.

Propellant system fuel and oxidizer lines for test fixture F-3 are being modified for compatibility with the simulated SPS rocket engine.

Reaction Control Systems

As a result of joint meetings between S&ID, Rocketdyne, and NASA, the configuration of the command module RCS engine has been modified. The final prototype engine design now incorporates the Gemini encapsulated throat insert, a one-piece macerated outer thrust chamber liner, and a tapered inner combustion chamber liner. Because the Gemini engine throat diameter has been increased, Apollo engines employing the Gemini encapsulated throat will now incorporate a nozzle expansion ratio of 9:1 instead of the 10:1 ratio originally selected. Increasing the nozzle exit area to retain the 10:1 ratio was judged undesirable because of associated structural changes to the command module.

Tests on three Phase I (boilerplate) engines were conducted by Rocketdyne. Each of the engines was operated in a pulse mode after acceptance and calibration tests. Some of the ablative material in the combustion chamber and nozzle of the second engine flaked away. This engine was operated at a 20-millisecond pulse width. Preliminary performance data values appear to be higher than predicted.

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Progress of the prototype service module RCS engine test program at Marquardt has been delayed because of operational difficulties encountered in altitude test cell 6. Although most of the problems have been resolved, Marquardt has not yet eliminated thrust measurement inconsistencies. Four prototype engines using three-coil solenoid valves are now available for test. The first prototype engine with two-coil solenoid valves will be available for test during the next report period.

Development tests have been conducted to improve service module RCS engine performance and to reduce injector head soak-back temperatures. Little performance improvement has been realized with injector configurations tested thus far, but some progress has been made in reducing soak-back temperature by decreasing the diameter of the thrust chamber at the forward end.

To simplify manufacturing and to reduce costs, an identical configuration for the tank-ends of the command and the service module RCS propellant systems is being sought. As a corollary to this study, mounting and porting features that would accept installation of such a configuration are being studied.

Electrical impulse counters were installed in both the service module and the command module RCS breadboard control panels to record rocket engine injector valve actuations. A precise record of actuations is required for (1) back-up information for rocket engine malfunctions and (2) reliability demonstration purposes.

Launch Escape System

A review of the launch escape motor nozzle configuration was instigated after the failure of a nozzle insert in the tower jettison motor. As a result, the steel retaining lip bearing area that supports the graphite insert was increased slightly. This modification will be initiated on the qualification motors. No schedule slippage is expected as a result of this modification.

Two static firings on tower jettison motors AD-6 and AD-8 have been made. The first temperature gradient firing in the development program was successfully accomplished at a temperature of 140 F with motor AD-8. Motor AD-6 was static tested after successfully undergoing temperature cycling and a package drop test; the temperature cycling, however, was only partially successful because of a nozzle insert failure. As a result of failure analysis, a new nozzle was designed that incorporates an additional insert bearing area and a styrofoam closure disc. Both tower jettison motors for boilerplate 6 have been modified to incorporate the new nozzle design and have been shipped to WSMR.

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Pitch control motors PC-11 and PC-12 were successfully static tested. An initial firing attempt with PC-12 was unsuccessful when the exploding bridge wire (EBW) initiators failed to function. A subsequent attempt with two new EBW initiators at a temperature level of 140 F resulted in normal operation. PC-11 was fired at a temperature level of 70 F.

PC-11 and PC-12 were designed for nominal total impulse levels of 1550 and 3000 pounds per second, respectively. Two subsequent motors, PC-16 and PC-19, have been cast with a total impulse level of 1700 pounds per second.

INTEGRATION

Ground Support Equipment

The ground cooling cart is being procured. Procurement of the following GSE models will be initiated within 30 days: vertical transporter, rail transfer unit, helium booster unit, and cryogenic transfer units.

To minimize servicing equipment, the SPS decontamination unit will service the entire SPS rather than just the service module propulsion engine.

The GSE telemetry channel assignment program for the IBM 1620 computer has been completed and is fully operational.

The checkout method for spacecraft 008 during environmental testing at Houston has been determined and documented. The proposed method is as follows:

1. The environmental chamber instrumentation system will be used for measurements external to the spacecraft.

2. Prelaunch automatic checkout equipment for spacecraft systems will be used to checkout the spacecraft systems. The prelaunch automatic checkout equipment will be similar to spacecraft 009 checkout equipment.

Reliability

S&ID and Grumman Aircraft initiated a program by which data concerning common usage parts, preferred parts lists, failure rates, qualification test procedures and data requirements, records, and retrieval

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procedures are being exchanged. Furthermore, Grumman will be placed on the distribution list for applicable S&ID reliability reports. The types of data needed from Grumman to maintain the over-all spacecraft reliability requirements were also discussed.

S&ID, Grumman, and MIT reviewed reliability analysis techniques, navigation and guidance system integration, command module/lunar excursion module electronic subsystem interfaces, and spacecraft electromechanical and power subsystems. MIT presented a list of spares candidates and included failure rates, weights and volumes, and the logic at the equipment level for the navigation and guidance system by mission phase. Navigation and guidance system interfaces between spacecraft and lunar excursion module as presented by MIT included:

1. Interchangeability of the inertial measurement unit between the command module and the lunar excursion module

2. Interchangeability of parts of the Apollo guidance computer (except the memory) and the coupling display unit

3. Radar equipment specifications that MIT and Grumman are coordinating and preparing

Reliability evaluation resulted in a recommendation for the acceptance of a design change to the heater of the cryogenic storage system (CSS). This change involves resizing the heater, so that it will be capable of heating both CSS oxygen tanks instead of one as currently planned. With both tanks being used to repressurize the command module, electrical power requirements would be cut in half. With lower power requirements, the reliability of the heater system would be enlarged (i.e., the duration of the applications of heat would be extended, resulting in fewer switching operations).

A reliability/crew safety design review of the CSS revealed a problem area in inspection techniques available for assuring satisfactory tank welds. Present dye penetrant methods were considered inadequate because the dye was incompatible with liquid oxygen. Equipment location in the tank makes the use of X-ray techniques difficult but relocation of internal equipment would reduce this problem. The present requirements of the applicable process specification are being reviewed and will be revised to assure a thorough inspection of all welds.

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GUIDANCE AND CONTROL

Eleven navigation and guidance interface control documents (ICD) have been submitted to MIT for approval. These ICD's cover the control signal interfaces with the SCS, the mechanical installation of the navigation and guidance system, and the synchronizing signal from the central timing equipment.

A preliminary navigation and guidance equipment failure analysis for the ΔV mode has been completed. This analysis identifies possible failures of such elements as the coupling and display units, portions of the computer, and the inertial measurement unit. The corrective action to be taken by the astronaut is identified, to evaluate the possibility of continuing the flight with the remaining navigation and guidance equipment or of indicating the requirement for a back-up mode. The study indicates that spares provisions for critical electronic packages in the power and servo assembly and computer will provide the possibility of regaining primary navigation and guidance operation through in-flight maintenance. Certain failures within the optics (such as servo motor failure) cannot be repaired in flight because of inaccessibility to optical components outside the pressure hull. Further effort will evaluate the use of the inertial measurement unit with the failure of certain components (such as a single accelerometer) without total subsystem failure, and to identify the requirements for back-up equipment and back-up procedures.

The design base for the SCS has been established with Minneapolis-Honeywell and procurement is proceeding compatible with need dates for delivered hardware. Some unresolved design decision areas are as follows:

1. Flight director attitude indicator ball markings are presently under study by Minneapolis-Honeywell, S&ID, and NASA. Changes to the present markings, to rotate the poles of the ball 90 degrees, may result.

2. Jet select logic schemes are being exercised for best tradeoffs between function and mechanization. Wires, switches, and system complexity will be compared with the most desired functions and fail safety features. The optimum compromise will be selected by the end of the next report period.

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OPERATIONS

DOWNEY

The command module interior structural work on boilerplate 6 was completed; the wiring harness was installed and checked out by the DITMCO console.

The Downey junction box is ready for use, and the junction box for WSMR is ready for shipment. The launch escape tower wiring harness has been checked out.

The research and development instrumentation breadboard for boilerplate 12 was received from NASA. The checkout is on schedule in accordance with the redirected one-week schedule slip caused by instrumentation calibration difficulties.

WHITE SANDS MISSILE RANGE

Direct shipment of the mission abort site motor room equipment to WSMR was started in April. Receiving and inspection are being accomplished. The U. S. Army laboratories at WSMR have made available a full capability for test and calibration, with a one-week turn-around on the more critical items.

ATLANTIC MISSILE RANGE

Apollo Test and Operations personnel at AMR have completed documentation of the preliminary AMR Apollo test and operations plan. This document, which pertains to the spacecraft checkout operations to be conducted at AMR, will be published during the next report period.

The service propulsion system (SPS) static firing facility concept was completed during the report period. The static firing area will be used only for conducting the SPS static firing. These tests will be controlled from the command module and from the command module simulator located in the blockhouse.

LOGISTICS SUPPORT

Training

Training material on the Apollo subsystems is being updated to include engineering changes, which consist primarily of those affecting the spacecraft panel displays.

The initial Apollo systems course material was submitted to NASA.

The preparation of Part III of the closed circuit television program, "This is Apollo," is completed and will be put on video tape during the next report period.

A briefing for NASA has been prepared for both the Apollo mission simulator and part-task trainer instructor manuals. To establish format and content requirements, a draft copy of the Apollo part-task trainer instructor manual will be completed during the next report period.

Supply Support

The recommended spare parts list for the Chrysler Apollo R & D instrumentation checkout console received NASA approval. The 1644 line items contained in the list are undergoing expedited procurement in order to support boilerplates 6 and 12 test events.

Procurement of spare parts for the Apollo part-task trainer has been initiated.

The priced spare parts list covering the parts released for spacecraft, GSE, and bulk item shop releases was submitted to NASA. The priced list covering GSE released prior to 1 March 1963 was also sent to NASA during this report period.

Logistics Engineering

The GSE planning and requirements document was updated during the report period. Since more than 60 percent of the document required revision, it was published as a reissue and dated 1 April 1963.

Manuals

The boilerplate 6 manuals will all be delivered to NASA by 1 May.

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FACILITIES

SUBCONTRACTOR COORDINATION

All subcontractors' facility requirements that will cause funding appropriations through 15 August 1963 will be defined and submitted to NASA during the next report period.

PLANT LAYOUT, AREA PLANNING, AND ADMINISTRATION

The Apollo mock-up display area is being moved and will be relocated to the preflight area during the next report period.

TEST SYSTEMS AND MANUFACTURING SUPPORT

The boilerplate test preparation and checkout interim area has been rearranged, and additional area has been assigned to Apollo Test and Operations. A new area to support subsequent boilerplate operations is being prepared.

The transfer of certain bonding operations to the new bonding building will take place during the next report period.

DOWNEY

The construction contract for the systems integration and checkout facility was awarded to the F. E. Young Construction Company, San Diego, California.

S&ID — NASA acceptance inspection of the bond and test facility was made on 12 April and occupancy of this building began on 15 April 1963.

Award of the construction contract for the environmental control system (ECS) portion of the space systems development facility is scheduled to take place during the next report period.

OFF-SITE

Facility requirements for the Merritt Island warehouse are being prepared for transmittal to NASA.

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APPENDIX A

S&ID SCHEDULE OF APOLLO MEETINGS AND TRIPS

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Appendix A

S&ID SCHEDULE OF APOLLO MEETINGS AND TRIPS

16 March to 15 April 1963

SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Negotiation base presentation	Cedar Rapids, Iowa	16-23 March	Hagelberg, Page, Albinger, Shear	S&ID, Collins
Specification review	Houston, Texas	17-18 March	Williamson, Zeek, Zemenick, Stungis	S&ID, NASA
Program Control coordination	White Sands, New Mexico	17-19 March	Stulting	S&ID, NASA
Negotiation base review	Houston, Texas	17-19 March	Toomey	S&ID, NASA
Northrop-Ventura negotiation base review	Houston, Texas	17-20 March	Wermuth, Edwards	S&ID, NASA
Space flight testing conference	Cocoa Beach, Florida	17-20 March	Jones, Patterson	Symposium
Crew systems meeting	Houston, Texas	17-21 March	DeWitt, Tutt, Stoll, Vucelic, Brewer, Tarr, Green	S&ID, NASA
Prime negotiations support	Houston, Texas	17-25 March	Fulton	S&ID, NASA

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
GSE coordination	Houston, Texas	17-28 March	Orville, Bagnall, Kiehlo	S&ID, NASA
Contract negotiations	Boulder, Colorado	17 March 4 April	Perry, Westfall, Carter, Greenfield, Haglund, White, Bouman, Miller	S&ID, Beech
Facility inspection	White Sands, New Mexico	17 March 5 April	Thompson	S&ID, NASA
Work transfer request coordination	Tulsa, Oklahoma	18 March	Sluga	S&ID, NAA-Tulsa
Configuration and change control preparation	Houston, Texas	18 March	Templeton, Freeman, Highland	S&ID, NASA
Nozzle failure discussion	Elkton, Maryland	18 March	Babcock	S&ID, Thiokol
Coordination meeting	Cincinnati, Ohio	18 March	Ryan, Westfall	S&ID, Cincinnati Test Laboratory
Destruct and dual curcuitry meeting	White Sands, New Mexico	18 March	Jacob	S&ID, NASA
Weight and balance setup	AMR	18 March	Moore, Hedger, Utecht	S&ID, NASA
Monthly coordination	Cocoa Beach, Florida	18 March	Pearce, Moore	S&ID, NASA
Environmental specification meeting	Downey, California	18-19 March	Clary	S&ID, NASA

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Honeycomb manufacturing progress	Middletown, Ohio	18-20 March	Fialho, Hermes, Hitt, Confer, Smith, Balin, Harrison	S&ID, Aeronca
Feasibility and Mar-aging steel evaluation	Beaver Falls, Pennsylvania; Latrobe, Pennsylvania	18-20 March	Stefins	S&ID, Babcock & Wilcox S&ID, Vanadium Alloys
Engineering and purchasing problems coordination	AMR	18-21 March	Blain	S&ID, NASA
Technical negotiations	Downey, California	18-22 March	Anderson	S&ID, Pratt & Whitney
Schedule milestones	Downey, California	18-22 March	Field	S&ID, NASA
Monthly and space flight conference	AMR	18-22 March	Moore	S&ID, NASA Symposium
Contract review	White Sands, New Mexico	18-22 March	Ansel	S&ID, El Paso Electric
Boilerplate modification	Newberry Park, California	18-23 March	Dowling, Widener, Gibbs, Burgess, Kiefe, Tupis	S&ID, Northrop-Ventura
Design coordination	White Sands, New Mexico	18-23 March	Doyle	S&ID, NASA
Contractual construction problems	Houston, Texas	19 March	Sack, Needham	S&ID, NASA
Specimens procurement	Wilmington, Massachusetts	19 March	Hanifin, King	S&ID, Avco

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Contract negotiations	Houston, Texas	19 March	Osbon	S&ID, NASA
Control and displays arrangements	Downey, California	19-20 March	Todd, Graham	S&ID, NASA
Thermal interface meeting	Downey, California	19-20 March	Todd	S&ID, NASA, MIT
Boilerplate status	Downey, California	19-20 March	Pyle	S&ID, NASA
Mating conference	Bethpage, Long Island	19-20 March	Ellis, Fentress, Stefan, Clauser	S&ID, Grumman
Facilities and launch complex meeting	AMR	19-20 March	Gardner	S&ID, NASA
Parachute drop test	El Centro, California	19-21 March	Stearns, Meyers	S&ID, USN
Boilerplate status	Downey, California	19-21 March	Pearce, Ewart	S&ID, NASA
Simulator meeting	Downey, California	19-21 March	McIntyre	S&ID, NASA
Breadboard testing and instrumentation coordination	Houston, Texas	19-22 March	Barmore	S&ID, NASA
Facility requirements coordination	White Sands, New Mexico	19-22 March	Mundy, Stungis, Proctor, Poole	S&ID, NASA
Plan, schedule, and cost review	White Sands, New Mexico	19-22 March	Bailey	S&ID, NASA
Guidance and control meeting	Houston, Texas	20 March	Miller, Knobbe, Jansen, Jarvis	S&ID, NASA

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Technical discussion	Houston, Texas	20 March	Fouts	S&ID, NASA
Flight technology panel and static force testing meeting	Houston, Texas	20 March	Dudek, Dodds, Raymes, Harthun, Primbs, Wiltse, Allen	S&ID, NASA
R & D instrumentation meeting	Downey, California	20-21 March	Pyle	S&ID, NASA
Electrical panel integration meeting	Houston, Texas	20-21 March	Turk, Dorman Crawford	S&ID, NASA
Northrop-Ventura base contract discussion	Houston, Texas	20-21 March	Lowry	S&ID, NASA
Design review	Manchester Connecticut	20-21 March	Young	S&ID, Pioneer Parachute
Reentry guidance meeting	Downey, California	20-22 March	Ewart, Lemke	S&ID, NASA
Facility survey	Camden, New Jersey	20-22 March	Langley, Day, Green, Forrette	S&ID, RCA
Costs and schedule meeting	Houston, Texas	20-22 March	Mundy	S&ID, NASA
Contract negotiations	Houston, Texas	20-23 March	Lane, Bevan	S&ID, NASA
Contract negotiations	Joplin, Missouri	20-24 March	Tapper, Otzinger, Milliken, Moore	S&ID, Eagle-Picher
Test requirements meeting	Cocoa Beach, Florida	20-30 March	Grycel, Kilham, Eng, McNery, Swanson, McMullin	S&ID, NASA

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Environmental and interface meeting	Houston, Texas	21 March	Dziedziula	S&ID, NASA
Engineering coordination	Sacramento, California	21 March	Ross, Thurman	S&ID, Aerojet-General
Electrical distribution meeting	Downey, California	21-22 March	Champaign	S&ID, NASA
Performance test	Fairchild, New York	21-23 March	Iwasaki	S&ID, Alderson Labs
Specification review	Cocoa Beach, Florida	22 March	Jorgensen, Hemond	S&ID, NASA
Contract negotiations	Houston, Texas	22 March	Lashbrook	S&ID, NASA
GSE meeting	Houston, Texas	22 March	Moody, McCoy, Mahan	S&ID, NASA
Schedule revision meeting	Downey, California	22-25 March	Paup	S&ID, NASA
P&W definitive contract	Downey, California	24 March	Frankhouse	S&ID, Pratt & Whitney
Boilerplate discussion	Cocoa Beach, Florida	25 March	McCoy	S&ID, NASA
GSE meeting	AMR	25 March	Mahan, Moody, Haight, Jensen, Lindley	S&ID, NASA
Source selection presentation	Houston, Texas	25 March	Kerr, Hatchell	S&ID, NASA
Navigation and guidance meeting	Cambridge, Massachusetts	25-26 March	Ferry	S&ID, MIT

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Aerojet negotiation base presentation	Houston, Texas	25-28 March	Weller, Cubley	S&ID, NASA
Docking simulation coordination	Columbus, Ohio	25-29 March	Thesing	S&ID, NAA-Columbus
Little Joe II program support	White Sands, New Mexico	25-29 March	Cooper, Walker	S&ID, NASA
Engineering plan completion	Melbourne, Florida	25 April	Sublett, Eiter, Moore, Bly, Stasko	S&ID; Radiation
Decision review	White Sands, New Mexico	26 March	Stungis, Proctor	S&ID, NASA
Biomedicine interface meeting	Bethpage, Long Island, New York	26 March	Hair	S&ID, Grumman
Reconciliation presentation	Houston, Texas	26-27 March	Paup, Sherman, Rider	S&ID, NASA
Facilities appendix review	Minneapolis, Minnesota	26-27 March	Dieterle	S&ID, Minneapolis-Honeywell
Spacesuit coordination	Downey, California	26-28 March	DeWitt	S&ID, NASA, Hamilton Standard, International Latex, Grumman
Antenna negotiation	Silver Springs, Maryland	26-29 March	Brooks, Dwyer	S&ID; Emertron
Integration coordination	Houston, Texas	26 March 1 April	Baum	S&ID, NASA
Facility installation	White Sands, New Mexico	26 March 4 April	Heaps	S&ID, NASA

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Program status review	Downey, California	27 March	Paup	S&ID, NASA
Partial contract termination	White Sands, New Mexico	27-29 March	Sack, Mundy, Proctor	S&ID, NASA
Nozzle failure review	Elkton, Maryland	27-29 March	Yee	S&ID, Thiokol
Test set and testing	Potrero, California	27 March 10 April	Cronin	S&ID, Lockheed
Wind tunnel tests	Mountain View, California	28 March	Vardoulis, Davey	S&ID, Ames
Contract negotiations	Houston, Texas	28 March	Lashbrook	S&ID, NASA
Master tooling coordination	Minneapolis, Minnesota	28 March	Gasparre	S&ID, Minneapolis-Honeywell
Wind tunnel tests	Tullahoma, Tennessee	28 March	Udvardy	S&ID, AEDC
Field analysis and negotiation performance	Silver Springs, Maryland	28 March	Dwyer, Brooks, McCabe	S&ID; Emertron
Firing unit investigation	Norwich, New York	28 March	Solomon	S&ID, G. L. A.
Personnel training	San Diego	28 March	Waters	S&ID, North Island Naval Training Station
Coating process review	Los Altos, California	27 March	Martinez, Mower, Olsen	S&ID, Advanced Materials & Process
Telemetry trailer discussion	Houston, Texas	27 March	Walker	S&ID, NASA

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Bolt suppliers coordination	Mesa, Arizona	27 March	Murphy	S&ID, Talley
Crew safety meeting	Houston, Texas	27 March	Vucelic, Nicholas	S&ID, NASA
Facility review	Minneapolis, Minnesota	27-28 March	Dieterle	S&ID, Minneapolis-Honeywell
Injector testing review	Sacramento, California	27-28 March	Mower	S&ID, Aerojet-General
Heat shield discussion	Wilmington, Massachusetts; Hampton, Virginia	27-28 March	Nowiciki, Cook	S&ID, Avco S&ID, Langley Research Center
System checkout	AMR	27-28 March	Grycel, Quebedeaux, Symons, Harper, Weido, Eckmeier, Charnock	S&ID, NASA
Mission planning and trajectory meeting	Houston, Texas	27-28 March	Rider, Myers, Clary, Jay, Jones, Milliken	S&ID, NASA
Heating conference	Houston, Texas	29 March	Greenschlag	S&ID, NASA
Coordination meeting	Sacramento, California	29 March	Madison	S&ID, Aerojet-General
Aerojet negotiation base presentation	Houston, Texas	31 March 2 April	Weller, Cubley	S&ID, NASA
Wind tunnel tests	Tullahoma, Tennessee	1 April	Udvardy, Clemmer	S&ID, AEDC
Collins support plan	Downey, California	1 April	Comensky	S&ID, Collins

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Aerojet negotiation base presentation	Houston, Texas	1-2 April	Field, Coulson, Ross, Cubley, Weller, Briggs, Flynn	S&ID, NASA
Collins second tier subcontract proposal	Houston, Texas	1-3 April	Shear	S&ID, NASA
AIAA conference	Palm Springs, California	1-3 April	Skene	Symposium
Checkout operations plan coordination	AMR	1-3 April	Jones	S&ID, NASA
Engineering plan completion	Melbourne, Florida	1-10 April	Sublett, Eiter, Bly, Stasko, Rosenblatt, Whitehead	S&ID; Radiation
Little Joe II and boilerplate support	White Sands, New Mexico	1-13 April	Kennedy	S&ID, NASA
Static firing test support	Redlands, California	1-19 April	Ullery, Mahan	S&ID, Lockheed
Facility installation support	White Sands, New Mexico	1 April	Black, Pyryembida	S&ID, NASA
Subcontractor negotiation meeting	Houston, Texas	2 April	Hagelberg, Page, Albinger	S&ID, NASA
Contract negotiations	Houston, Texas	2 April	Lashbrook, Sack	S&ID, NASA
Facility coordination and cluster drop monitoring	Newberry Park, California	2 April	Poole	S&ID, Northrop-Ventura
Problem area discussion	Downey, California	2-3 April	DeWitt	S&ID, NASA

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Document review	Houston, Texas	2-3 April	Rupert, Wang, Johnson	S&ID, NASA
Interfaces definition meeting	Downey, California	2-4 April	Wheelock, Lane	S&ID, Grumman
Specification revision definitization	Buffalo, New York	2-5 April	Myers, Gibb, Wagner, Burge, Glienke, Keech, O'Brian	S&ID, Bell Aerosystems
SCS diagram development and design review	Minneapolis, Minnesota	2-5 April	Garcia, Elleri, DaVanzo, Spray, Miller, Kalayjian	S&ID, Minneapolis-Honeywell
EMI coordination	Cedar Rapids, Iowa	2-5 April	Kronsberg, Calvert	S&ID, Collins
Subcontractor coordination	Elkton, Maryland; Hartford, Connecticut	2-9 April	Griffith-Jones, Barker, Frankhouse	S&ID, Thiokol S&ID, Pratt & Whitney
Hardline installation documentation	Huntsville, Alabama	2-12 April	Ward	S&ID, NASA
Test requirements establishment	AMR	2-12 April	Grycel	S&ID, NASA
Northrop-Ventura contract base review	Newberry Park, California	3 April	Lowry	S&ID, Northrop-Ventura
Wind tunnel test discussion	Tullahoma, Tennessee	3 April	Ufer	S&ID, AEDC
Wind tunnel test discussion	Huntsville, Alabama	3 April	Allen, Takvorian	S&ID, NASA
Chamber requirements coordination	Houston, Texas	3 April	Rigas, Corvese	S&ID, NASA

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Technical negotiations	Hartford, Connecticut	3-5 April	Barker, Myer, Nash, Cahampaign	S&ID, Pratt & Whitney
Schedule coordination	AMR	3-10 April	Toppel, Manners	S&ID, NASA
Overtime requirements discussion	Redlands, California	4 April	Gill	S&ID, Lockheed
Radiation shielding study program	Huntsville, Alabama	4 April	Raymes	S&ID, NASA, United Nuclear
Specifications and circuitry discussion	Minneapolis, Minnesota	4-5 April	Hindi, Wurzburg, Witsmeer	S&ID, Minneapolis-Honeywell
Emergency egress participation	AMR	4-5 April	Gardner, Carney, Henry, Dupaquier, King, Stevens	S&ID, NASA
Flight date-uplink meeting	Cambridge, Massachusetts	4-5 April	Allen, Hamilton	S&ID, MIT
Technical negotiations	Menlo Park, California	4-5 April	Hair, Voss, Tarr	S&ID, Space Research
Guidance analysis panel meeting	Cambridge, Massachusetts	4-5 April	Louie, Hedwig, Davis, Oglevie, Meston	S&ID, MIT
Minneapolis-Honeywell negotiation base presentation	Houston, Texas	4-5 April	Rothacher, Anderson, Mihelich	S&ID, NASA
S-band transponder design meeting	Phoenix, Arizona	4-5 April	Robinson, Hall, Frost	S&ID, Motorola
Contract negotiations	Houston, Texas	4-12 April	Sack	S&ID, NASA

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Test firing injector discussion	Sacramento, California	5 April	Mower, Szalwinski	S&ID, Aerojet-General
Air drop preparation	El Centro, California	6-12 April	Dowling, Cooper, Breeland, Gregg, Gutierrez, Woolever, Widener, Brayton, Aperlo, Bigenho, Scott, Poole, Necker	S&ID, 6511th Test Group
Northrop-Ventura negotiation base review	Houston, Texas	7-9 April	Wermuth, Lowry	S&ID, NASA
Logistics requirements meeting	Tulsa, Oklahoma	7-11 April	Miltko	S&ID, NAA-Tulsa
Contract displays	Downey, California	8 April	Ewart	S&ID, NASA
Test program coordination	Tullahoma, Tennessee	8 April	Cadwell	S&ID, AEDC
Logistics documentation status review	Culver City, California	8-9 April	Comensky	S&ID, NASA
GOSS system meeting	Houston, Texas	8-9 April	Kiehlo, Moore, Strelow, O'Malley	S&ID, NASA
SAE meeting	Washington, D.C.	8-9 April	Kinsler	Symposium
Measurement requirements meeting	Houston, Texas	8-9 April	Tomita, Barmore	S&ID, NASA
Test panel participation	Houston, Texas	8-10 April	Overman, Spengler, Altenbernd	S&ID, NASA
Tubing evaluation	Beaver Falls, Pennsylvania	8-9 April	Stefins	S&ID, Babcock & Wilcox

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Logistics requirements meeting	Bethpage, Long Island, New York	8-10 April	Norbut	S&ID, Grumman
Jet plume tests	Tullahoma, Tennessee	8-26 April	Piesik, Lofland	S&ID, AEDC
Full pressure suit coordination	Dover, Deleware	9 April	Rinehart	S&ID, International Latex
IFTS procurement	Palo Alto, California	9 April	Matisoff	S&ID, Philco
Instrumentation list coordination	Houston, Texas	9 April	Wolff	S&ID, NASA
Technical coordination	Cedar Rapids, Iowa	9 April	Griffiths, Kronsberg	S&ID, Collins
Logistics data meeting	Azusa, California	9 April	Madison	S&ID, Aerojet-General
Proximity firing and abort criteria	Houston, Texas	9 April	Koppang, Hackett, Geheber	S&ID, NASA
Logistics support meeting	Houston, Texas	9-10 April	Paden, Powelson, Sandham, Fore, Warriner	S&ID, NASA
Test procedure discussion	Houston, Texas	9-10 April	Taylor, Sheeran	S&ID, NASA
Control problem discussion	Hartford, Conneticut	9-10 April	Bills, Mackay	S&ID, Pratt & Whitney
Flight test panel meeting	Houston, Texas	9-11 April	Moore, Altenbernd, Spenger, Williamson, Cole, Overman, Gustavson, Cooper	S&ID, NASA
Training requirements meeting	Houston, Texas	9-11 April	Pfanner	S&ID, NASA

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
GSE coordination	Houston, Texas	9-11 April	Lindley, Garing, Davis, Gebhart, Altenbernd, Munford, Shelley	S&ID, NASA
Military handbook 5 meeting	San Diego, California	9-11 April	Calfin	Symposium
Checkout plan development	AMR	9-12 April	McMullin, Kilham, Kinsinger, Eng, McNerney	S&ID, NASA
Facilities coordination and establishment	White Sands, New Mexico	9-12 April	Ginley	S&ID, NASA
Monthly electrical power meeting	Houston, Texas	10 April	Quebedeaux, Stoll, Anderson, Barnett, Sheere, Ross, Snyder	S&ID, NASA
Engineering liaison	Elkton, Maryland	10-11 April	Bergeron	S&ID, NASA
System facility checkout	Houston, Texas	10-11 April	Lindley, Shelley, Overman, Corverse, Altenbernd, Gebhart	S&ID, NASA
Solar flare prediction discussion	Alamogordo, New Mexico	10-11 April	Park	S&ID, Sacramento Peak Observatory
Mar-aging steel meeting	Labrobe, Pennsylvania	10-11 April	Stefins	S&ID, Vanadium Alloys
Tie-in trainers discussion	Houston, Texas	10-11 April	Marshall, Neff, Secrist, McIntyre, Pfanner	S&ID, NASA
GSE liaison	Tulsa, Oklahoma	10-12 April	Haigler	S&ID, NAA-Tulsa

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Fact finding meeting	Minneapolis, Minnesota	10-13 April	Lu, Flatto, Jansen, Lum, Peterson, Robins, Ruiz, Tutt	S&ID, Minneapolis-Honeywell
Senior resident representative introduction	Bethpage, Long Island, New York	10-14 April	Berry, Weiss	S&ID, Grumman
AiResearch cost negotiations	Los Angeles, California	10-19 April	Seibel	S&ID, AiResearch
Camera installations meeting	Houston, Texas	11 April	Eich, Marks	S&ID, NASA
Interface meeting	Downey, California	11-12 April	Rollins	S&ID, MIT, Minneapolis-Honeywell
Coordination meeting	Houston, Texas	11-12 April	Ryan	S&ID, NASA
Contract negotiations	Houston, Texas	11-12 April	Sack, Coulson	S&ID, NASA
Crew performance discussion	New York, New York	11-14 April	Traux	S&ID, Eastern Psychological Association
Technical fact finding meeting	Minneapolis, Minnesota	11-16 April	Stady	S&ID, Minneapolis-Honeywell
Engineering coordination	Downey, California	11-19 April	Berkemeyer	S&ID, Collins
Interface systems meeting	Downey, California	11-21 April	Rollins	S&ID, Minneapolis-Honeywell
Parachute drop test coordination	El Centro, California	12 April	Rodier, Ellis, Yound, Byrd	S&ID, 6511th test group
Field survey	Chicago, Illinois; Buffalo, New York; Boston, Massachusetts	14-22 April	Langley, Matisoff	S&ID, ITT S&ID, Sylvania S&ID, RCA

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SUBJECT	LOCATION	DATE	S&ID REPRESENTATIVES	ORGANIZATION
Wind tunnel tests	Tullahoma, Tennessee	15-16 April	Berthold, Pagaza	S&ID, AEDC
Training meeting	Houston, Texas	15-16 April	Pollard	S&ID, NASA
Docking simulation	Columbus, Ohio	15-17 April	Bohlen, Scheiman, Hambleton, Mason	S&ID, NAA-Columbus
Checkout panel meeting	Houston, Texas	15-18 April	Kiehlo	S&ID, NASA
Program surveillance maintenance	Hartford, Connecticut	15-19 April	Frankhouse	S&ID, Pratt & Whitney
Contract negotiations definitization	Bethpage, Long Island, New York	15-22 April	Moore	S&ID, Alderson Research
Work transfer request coordination	Tulsa, Oklahoma	15 April 1 July	Sluga	S&ID, NAA-Tulsa

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APPENDIX B

DOCUMENTATION LIST

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DOCUMENTATION LIST

The following documents were published during the report period:

SID 62-99-14	Monthly Weight and Balance Report for the Apollo Spacecraft
SID 62-300-11	Monthly Progress Report for the Period 16 February to 16 March 1963
SID 62-384-28	Drawing List Apollo Spacecraft Complete
SID 62-1408-1	Apollo Measurement Requirements, Master Measurement List
SID 62-1408-2	Apollo Measurement Requirements, Boilerplate Measurement List
SID 62-109-1	General Test Plan Research and Development for Project Apollo Spacecraft General Test Plan Summary
SID 62-109-2	General Test Plan Research and Development for Project Apollo Spacecraft Individual Systems Test
SID 62-109-3	General Test Plan Research and Development for Project Apollo Spacecraft Ground Qualification Tests
SID 62-109-4	General Test Plan Research and Development for Project Apollo Spacecraft Acceptance Test Plan
SID 62-109-5	General Test Plan Research and Development for Project Apollo Spacecraft Multiple Systems Tests
SID 63-180	Apollo Documentation List
SID 62-417	Ground Support Equipment Planning and Reports
SID 63-21-4	Monthly Quality Status Report Apollo Spacecraft
SID 63-193	Structural Analysis of the Apollo 0.045-Scale FSJ-3 Force Model

SID 62-1437	Static Stability and Force Characteristics of an 0.02-Scale Model of the Saturn C-1 Launch Vehicle with Apollo Payload for the Mach No. Range 3.5 to 8.0
SID 62-1391	Static Stability and Force Characteristics of an 0.02-Scale Model of the Saturn C-1 Launch Vehicle with Apollo Payload for the Mach No. Range 0.70 to 3.5
SID 62-1468	Static Stability and Force Characteristics of an 0.02-Scale Model of the Saturn C-1 Launch Vehicle with Apollo Payload for the Mach No. Range 0.4 to 3.5
SID 62-384-28	Motion Picture Photography Submittal
SID 62-367-53	Motion Picture Photography Submittal
SID 62-367-54	Motion Picture Photography Submittal
SID 62-566-26	Motion Picture Photography Submittal
SID 62-566-27	Motion Picture Photography Submittal
SID 62-566-28	Motion Picture Photography Submittal
SID 62-367-55	Motion Picture Photography Submittal
SID 62-367-56	Motion Picture Photography Submittal
SID 62-367-57	Motion Picture Photography Submittal
SID 62-367-58	Motion Picture Photography Submittal
SID 62-367-59	Motion Picture Photography Submittal
SID 62-367-61	Motion Picture Photography Submittal